A device for slowing the movement of a door, drawer or similar movable member, having releasable locking means

The present invention relates to a device for slowing the movement of a door, drawer or similar member which is movable with respect to a fixed structure and urged by unidirectional thrust means, of a type described in the preamble to Claim 1.

A device of this type is known from British Patent Application GB-A 2 062 933 and is normally used to smooth the movement of a slidable drawer caused by spring means, as used in certain types of ashtray fitted in the dashboard of motor vehicles, or of pivoted doors, of a type used, for example in tape recorder apparatus.

It is also known that such drawers or doors often have latch closure means which are released by a light pressure on the drawer, so that pressure is used to carry out both opening and closing operations.

The document US-A-4 893 522 describes a rotary damper including a cylindrical rotor, a casing with a shaft for insertion into the cylindrical rotor and a cylindrical wall enclosing this shaft, with a viscous fluid between the inner surface of the cylindrical rotor and the casing shaft. A spiral spring is fitted between the cylindrical wall of the casing and the outer surface of the rotor and is wound up by the rotation induced by an applied torque. This device has incorporated latch closure means, including an excursion groove formed either in the inner surface of the casing lid or in an end surface of the cylindrical rotor and having a heart-shaped cam groove at one end and an operating pin

either provided on the lid or on the cylindrical rotor, operable to slide along the groove.

The document EP-A-0 199 242 describes a device in which the latch closure means include a sphere engaged in a rectilinear groove, formed in the lateral surface of the stator, and urged by a shaped groove formed in the lateral wall of the rotor and having a cam defining a forward path and a return path for the sphere.

The object of the present invention is a device for slowing the movement of a door or drawer of a compact type, having the characteristics defined in the Claims.

A few preferred but non-limitative embodiments of the invention will now be described with reference to the appended drawings, in which:

- Figure 1 is a longitudinally sectioned view of the structure of the door of a tape recorder incorporating a slowing device according to the invention;
- Figure 2 is a longitudinally sectioned view of an embodiment of a slowing device according to the invention;
- Figure 3 is a plan view of a component of the device of Figure 2;
- Figure 4 is a section of the slowing device of Figure 2 taken on the line IV-IV of Figure 3
- Figure 5 is a plan view of another component of the device of Figure 2;
- Figures 6-14 are plan views illustrating the operation of the slowing device of the invention;
- Figure 15 is a plan view of a second embodiment of the slowing device of the invention;

- Figure 16 is a longitudinal section of the device of Figure 15, taken on the line XVI-XVI of this drawing;
- Figure 17 is a section of the device of Figure 15, viewed from below and taken on the line XVII-XVII of figure 16;
- Figure 18 is a plan view of a third embodiment of the slowing device of the invention;
- Figure 19 is a longitudinal section of the device of Figure 18, taken on the line XIX-XIX of this drawing;
- Figure 20 is a section of the device of Figure 18, viewed from below and taken on the line XX-XX of Figure 19.

With reference to Figure 1, numeral reference 2 designates a door, for example, the door of a tape recorder, pivoted about a hinge 3 fixed to the structure S of this recorder, while 4 indicates a spring which urges the door into its open position. A curved rack 6, the centre of curvature of which coincides with the pivot axis of the door 2, is secured to this door. A slowing device 15 of the invention is also secured to the structure S of the recorder, with a rotatable pinion 16 arranged so as to engage the teeth of the rack 6.

With reference to Figure 2, the device 15 substantially includes a casing 17, defining internally a substantially cylindrical chamber 18 open at one end, and having a pair of lateral extensions 19 in which through holes 19a are formed for engaging fixing means 19b (shown in Figure 1) such as screws, rivets and the like for rigidly securing these extensions 19 to the structure S of the recorder, with the pinion 16 engaged with the rack 6. The open end of the cylindrical chamber 18 is adapted to be closed by a lid 21 which is fixed to the casing 17 so as to provide a fluidtight seal, for example by gluing or welding. The lid 21 has a central through-hole 22. The base 23 of the

cylindrical chamber 18, corresponding to the base of the casing 17, has a pin portion 24 which projects axially from the centre of the base 23 of the chamber 18 inwardly thereof.

The device 15 also includes a rotor 31 housed in the chamber 18. The rotor 31 includes a disc portion 32, rotatable inside the casing 17, and a shaft portion 33 which extends axially from the centre of the disc portion 32 and protrudes from the lid 21 of the casing 17, passing through the central hole 22. The free end 33a of the shaft portion 33 of the rotor 31 is arranged so the pinion 16 can be mounted thereon. The rotor 31 also has a central hole 34, formed in the base of the disc portion 32 for enabling the rotor 31 to be mounted on the pin portion 24 of the casing 17 and providing thereby an axis of rotation for the rotor.

The chamber 18 is filled with a highly viscous fluid of a known type, in such a way that the rotor 31 is fully immersed. The fluidtight seal at the central hole 22 is ensured by an O-ring 41 housed in a circular seat 42 formed around the central hole 22 through the lid 21.

With reference also to Figures 3 and 4 (for the sake of clarity, in Figure 3 the casing 17 is shown without the lid 21 and the rotor 31), the base surface 23a of the chamber 18 has a recess 51 with an arm element 52 housed therein, mounted pivotably on a pin 53 formed in one piece with the base of the recess 51. The arm element 52 includes an integrally formed elongate body 52a, with a thickness along the length of the device 15 less than or equal to the depth of the recess 51. One end 52b of the body 52a of the arm element 52 is pivoted on the pin 53, while the other end 52c has a pin portion 54 projecting from the base surface 23a

inwardly of the cylindrical chamber 18. Due to this configuration, the arm element 52 is able to oscillate in the bottom of the recess 51, in a plane parallel to the base surface 23a. The shape of the recess 51 can be different from that shown in Figure 3 but it must be able to allow the arm element 52 to pivot sufficiently in order for the device to operate, as will be described later.

Figure 5 is a plan view just of the rotor 31. It has a pair of vane portions 61 extending radially from diametrically opposite sides of the disc portion 32. An elongate groove 70 (shown in the broken line) is formed in the lower surface 62 of the disc portion 32 and of the paddle elements 61, that is the surface opposite the base surface 23a so as to extend concentrically with the shaft portion 33 of the rotor 31. In particular, this groove 70 extends to the edge of the disc portion 32 so it is substantially divided into three portions on the vane portions 61. The first and second portions 71, 72 constitute an end portion and an intermediate portion of a part of the groove 70 concentric with the shaft portion 33 of the rotor 31. These portions 71, 72 are formed in such a way that their radially inner walls 71a, 72a are blended with the side wall 32a of the disc portion 32. In an improved embodiment (not shown) the portion 72 is provided with flared ends so as to form mouths, the function of which will be explained later. The third portion 73 forms the opposite end of the groove 70 and extends so as to approximately form a ring, with forward and return branches 74, 75, respectively, and a cam portion 76 interposed between them. The radially inner wall of the mouth of the forward branch 74 is connected to the radially outer wall 32a of the disc element 32.

A recess 77 is formed in the cam portion 76, in front of which a cuspid branch 78 is extended which interconnects the two branches 74, 75 of the groove 70. The cuspid branch 78 defines two sharp bends 79, 81 at its ends, substantially opposite the recess 77 of the cam portion 76.

The groove 70 is engageable by the pin portion 54 of the arm element 51, which moves along the groove when the rotor 31 is rotated relative to the casing 17. After passing through the portions 71, 72, the pin portion 54 engages in succession the branches 75 and 74 of the groove 70, accompanied by the movement of the arm element 52, thereby accomplishing locking and release operations in the manner of the pressure latch system described with reference to the prior art.

Figures 6 to 14 illustrate the operation of the device according to the invention.

From the latched position (Figure 6) in which the pin portion 54 engages the recess 77 of the cam portion 76, pressure applied on the door 2 causes a slight clockwise rotation of the rotor 31, by means of the rack 6 engaged with the pinion 16, thereby causing the pin portion of the arm to be moved away from the recess (see Figure 7) until it reaches the bend 79, beyond which clockwise rotation is prevented (see Figure 8). The arm element 52 pivots slightly anti-clockwise, following the movement of the pin portion 54 induced by the rotor 31.

When pressure on the door 2 is released, the spring 4 urges it until it is fully open. The movement transmitted to the rotor 31 causes it to rotate anti-clockwise, whereby the pin portion 54 (see Figure 9) passes along the forward branch 74,

the intermediate portion 72 and the end portion 71 until it reaches the end of travel position defined by the end portion 71 (see Figure 10). In addition to slowing the movement of the rotor 31, and therefore of the door 2, the viscosity of the viscous fluid prevents the pin portion 54 and the arm portion 52, which pivot clockwise while moving along the forward branch 75, from moving away radially from the path of the groove 70 in the portion in which this is interrupted (see Figure 9).

If pressure continues to be exerted on the door 2, the rotor 31 rotates clockwise (see Figure 11) and the pin portion 54 returns along the groove 70 until it is diverted by the cam portion 76 into the return branch 75, whereby the arm element 52 reaches its position of maximum clockwise travel (see Figure 12). The mouth of the forward branch 74 is much narrower than that of the return branch 75, in order to reduce the possibility of the pin element 54 entering this branch by mistake when it reaches the end portion 73 of the groove 70.

If pressure on the door 2 is continued, the rotor 31 rotates until the pin portion 54 engages the bend 81 of the return branch 75, which prevents further rotation (see Figure 13).

If pressure is released, the action of the spring 4 causes the rotor 31 to rotate slightly anti-clockwise (see Figure 14) and, thanks to the configuration of the cuspid branch 78, the pin portion 54 is guided to the recess 77 of the cam portion 76, once again locking the rotor 31 into the starting position shown in Figure 1.

A second embodiment of the slowing device of the invention will now be described with reference to Figures 15 to 17. Elements which are the same as those of the previous embodiment are indicated with the same reference numbers followed by an apostrophe. This embodiment is substantially similar to the previous one, therefore only those elements which are different will be described, and reference should be made to the previous description for any remaining details.

In the present embodiment, generally indicated 15', a casing 17', which defines internally a substantially cylindrical chamber 18' open at one end, has a radial extension 17a' and, on opposite sides with respect to the direction defined by the radial extension 17a', a pair of lateral wings 19' each having a resilient flap portion 19b' extending upwardly. These portions 19b' are provided for rapid engagement coupling with one of the two bodies whose relative movement needs to be slowed, for example with the structure S of the tape recorder. These portions 19b' could, of course, be of a different shape, being folded downwards, for example, or the lateral wings 19' could have fixing holes similar to those of the embodiment described earlier.

A rotor 31' housed inside the chamber 18' comprises a disc portion 32' arranged inside the chamber 18' and a shaft portion 33' which extends axially from the centre of the disc portion 32' and protrudes from a lid 21' of the chamber 18', passing through a central hole 22' through this lid 21'. An intermediate axial portion 33b' of the shaft portion 33' of the rotor 31' is arranged so that a rotatable arm element 35' can be mounted, while the free end 33a' of the shaft portion 33' is fixable to one of the two bodies whose relative

movement needs to be slowed, for example to the door 2. Unlike the previous embodiment, the device 15' is intended to be mounted at the pivot axis of the door 2, in such a way that this pivot axis coincides with the axis of rotation of the rotor 31'. The coupling provided by the pinion 16 and the rack 6 is therefore no longer required.

The rotatable arm element 35', which extends radially from the shaft portion 33' of the rotor 31', is able to rotate integrally with the rotor 31', passing over the radial extension 17a' of the casing 17'. As will be explained later, it is necessary to maintain a narrow space 36' between the opposing surfaces of the shaft portion 33' and the radial extension 17' when, during its rotation, the rotating arm element 35' passes over the radial extension 17a'. To this end, the radial extension 17a' has a flap portion 37' which extends substantially vertically from its distal end and has a free end 37a' folded inwardly, so as to form a stop for limiting flexure of the distal portion of the rotatable arm element 35'.

With reference to Figures 15 and 16, the upper surface 17b' of the radial extension 17a' of the casing 17' has a recess 51', housing within it a pivotable arm element 52', in a manner similar to that described with reference to the previous embodiment.

With reference to Figures 15 and 17, the lower surface 35a' of the rotatable arm element 35' of the rotor 31', that is the surface opposite the upper surface 17b'of the radial extension 17a', has a groove 70' which extends substantially transverse the length of the rotatable arm element 35', that is along the direction of rotation of the rotor 31'. This

groove 70' includes two separate end portions 71' and 73' with respective mouths arranged on respective lateral walls of the rotatable arm element 35'. These end portions 71' and 73' are of a similar shape to the end portions 71 and 73 of the groove 70 of the previous embodiment, in order that, when the rotatable arm element 35' is passing over the radial extension 17a', the engagement between the pivotable arm element 52' of the radial extension 17a' of the casing 17' and the groove 70' of the rotatable arm element 35' of the rotor 31' defines a cam retaining mechanism substantially identical to that of the previous embodiment. The groove 70' is of course of a shape and dimension enabling the latch mechanism to be controlled by acting on the door 2 with angular movements of different amplitude, since in the present example the axis of rotation of the rotor 31' coincides with the pivot axis of the door 2.

A third embodiment of the slowing device of the invention will now be described with reference to Figures 18 to 20. Elements which are the same as those of the previous embodiments have been given the same reference number followed by two apostrophes. The present embodiment is substantially similar to the second, therefore only those elements which differ will be described, reference being made to the descriptions of the first and second embodiments for any remaining details.

In this embodiment, generally indicated 15'', a casing 17'', defining internally a substantially cylindrical chamber 18'', has a radial extension 17a''. The cylindrical chamber 18'' is open at one end, while the other end is provided with a base 23'' with a central through hole 23a'' and a pin portion 24'' projecting axially from the centre of the base 23'' of

the chamber 18'' inwardly of the chamber, with the hole 23'' coaxially passing through it.

A rotor 31'' housed within the chamber 18'' comprises a disc portion 32'' inside the chamber 18'' and a shaft portion 33'' which extends axially from the centre of the disc portion 32'' and protrudes through the central hole 23a'' in the base 23'' of the chamber 18''. The free end 33a'' of the shaft portion 33'' of the rotor 31'' is arranged for enabling a rotatable arm element 35'' to be fitted. The rotor 31'' has a coaxial through-hole 31a'', aligned with a central hole 22'' through a lid 21'' which closes the open end of the chamber 18''. The through-hole 31a'' of the rotor 31'' is arranged for securing to a rod (not shown) which defines a pivot axis for the door 2 fixed to the structure S. The radial extension 17a'' of the casing 17'' is fixable to the door 2. In the same way as in the second embodiment, the device 15'' is intended to be mounted coincident with the pivot axis of the door 2, in such a way that this pivot axis coincides with the axis of rotation of the rotor 31''. However, while in the second embodiment the device 15' is intended to be positioned laterally in relation to the door 2, in the third embodiment the device 15'' is intended to be positioned in a mid position along the pivot axis of the door 2.

The rotor 31'' has a plurality of vane portions 61'' extending axially from the periphery of the disc portion 32'', between the pin portion 24'' and the wall of the cylindrical chamber 18'', while the disc portion 32'' is enclosed between the lid 21'' of the cylindrical chamber 18'' and the top of the pin portion 24''.

Extending radially from the shaft portion 33'' of the rotor 31'', the rotatable arm element 35'' of the rotor 31'' is able to rotate with the rotor 31'', passing beneath the radial extension 17a'' of the casing 17''. The positions of the radial extension 17a'' of the casing 17'' and of the rotatable arm element 35'' of the rotor 31'' are reversed compared to those of the second embodiment. A space 36'' is defined between the radial extension 17a'' and the rotatable arm element 35'' and kept small by a flap portion 37'' which extends substantially vertically from the distal end of the rotatable arm element 35'' and has a free end 37a'' folded inwards.

With reference to Figures 18 and 19, the upper surface 35a'' of the rotatable arm element 35'' has a recess 51'' with a pivotable arm element 52'' housed therein, in a similar manner to that described with reference to the previous embodiments.

With reference to Figures 18 and 20, the lower surface 17b'' of the radial extension 17a'', that is the surface opposite the upper surface 35a'' of the rotatable arm element 35'', has a groove 70'' extending substantially transverse the length of the radial extension 17a'', in a manner substantially identical to that described with reference to the second embodiment.

It will be appreciated that, although it has internal latch means, the slowing device according to the first embodiment of the invention has a structure which is more compact and is simpler to manufacture than the prior art, wherein the axial depth of the casing can be of only a few millimetres, while maintaining the high reliability of the device. In

particular, the Applicant has made the portion 73 of the groove 70 with an angular extent of around 10-20° in a device with a diameter of around 1.5cm. In this way, by fitting this device with the rack 6, it is possible to activate the release mechanism with an angular movement of the door of only a few degrees.

The devices according to the second and third embodiments of the invention are suited, on the other hand, to be fitted directly onto the pivot axis of the door 2. By arranging the portion 73', 73'' of the groove 70', 70'' on the rotatable arm element 35' or on the radial extension 17a'', it is possible to adapt the angular extent of this portion 73', 73'' and its distance from the axis of rotation of the rotor 31', 31'' to the extent of the angular movement required in order to release the latch mechanism (which normally depends on the height of the door 2).

It is understood that the invention is not limited to the embodiments described and illustrated here, but that the shape and arrangements of parts, construction and operating details can be modified. In the first embodiment, for example, the arm element could be mounted on the disc portion of the rotor, while the groove could be formed in the base of the chamber itself. Alternatively, it is possible to arrange these latch means between the upper surface of the disc portion and the lower surface of the casing lid, or on both sides of the disc portion.

The groove 70, 70', 70'' can of course be orientated as a mirror image of that described, thereby causing the device to be locked or released by rotation in the opposite sense to that described above.

In addition, the device according to the first embodiment can be coupled with a rectilinear rack in order to control the movement of a slidable drawer.